

# **STABILIZING SOLUTIONS FOR SUBMICRONIC PARTICLES, METHODS FOR MAKING THE SAME AND METHODS OF STABILIZING SUBMICRONIC PARTICLES**

## **FIELD OF THE INVENTION**

[0001] This invention relates to nano submicronic particles and particularly, it relates to a stabilizing solution for submicronic particles, methods for making these stabilizing solutions and methods of stabilizing submicronic particles to form stable nano submicronic particles.

## **BACKGROUND OF THE INVENTION**

[0002] Submicronic particles are particles less than 1 micron and include nano scale particles. Nano particles are part of an emerging science called 'nano technology'. The word nano technology comes from the Greek prefix 'nano' meaning "one billionth". In modern scientific parlance, a nanometer is one billionth of a meter, about the length of hydrogen atoms placed side by side in a line. The smallest things that an unaided human eye can see are 10,000 nanometers across. Nano particles are typically and generally spherical in shape.

[0003] Nanoscience, simply, is the study of the fundamental principles of structures with at least one dimension roughly between 1 and 100 nanometers and Nanotechnology is the application of these nanostructures into useful nanoscale devices.

[0004] Nano scale particles of substances exhibit properties unlike the properties of their macro counterparts often with stunning new results. Nano scale is unique because it is the size scale where the familiar day-to-day properties of materials like conductivity, hardness or melting point meet the more exotic properties of the atomic and molecular world such as wave-particle duality and quantum effects. At the nano scale, the most fundamental properties of the materials and machines depend on their size in a way they don't at any other scale. For e.g. a nano scale wire or circuit component does not necessarily obey Ohm's law. Nano-scale particles have unique physical properties (e.g. optical, dielectric, magnetic, mechanical), transport properties (e.g., thermal, atomic diffusion) and processing characteristics (e.g., faster sintering kinetics, super-plastic forming).

[0005] Physicist Richard Feynman first described the possibility of molecular engineering. In 1959 Feynman gave a lecture at the California Institute of Technology called "There's Plenty of Room at the Bottom" where he observed that the principles of physics do not deny the possibility of manipulating things atom by atom. He suggested using small machines to make even tinier machines, and so on down to the atomic level itself. Nano technology as it is understood now though, is the brainchild of Feynman's one-time student K. Eric Drexler. Drexler presented his key ideas in a paper on molecular engineering published in 1981, and expanded these in his books *Engines of Creation* and *Nano systems: Molecular Machinery, Manufacturing and Computation*, which describes the principles and mechanisms of molecular nano technology.

[0006] In 1981 the invention of the Scanning Tunneling Microscope or STM, by Gerd Binnig and Heinrich Rohrer at IBM's Zurich Research Labs, and the Atomic Force Micro-

scope (AFM) five years later, made it possible to not only take photos of individual atoms, but to actually move a single atom around. Soon after, John Foster of IBM Almaden labs was able to spell "IBM" out of 35 xenon atoms on a nickel surface, using a scanning tunneling microscope to push the atoms into place.

[0007] A nanometer is a magical point on the dimensional scale. Nano structures are at the confluence of the smallest of Human-made devices and the largest molecules of the living things. Nano technology exploits the new physical, chemical and biological properties of systems that are intermediate in size, between isolated atoms/molecules and bulk materials, where the transitional properties between the two limits can be controlled.

[0008] The synthesis and characterization of nano particles has received attention in recent years because of the possibility of their widespread use in industry and chemistry. Nanotechnology is gaining importance in areas such as biomedical sciences, optics, electronics, magnetism, mechanics, ceramics, catalysis and energy science. However, the preparation of such nano structured materials poses several unique challenges. A range of nano particles has been produced by physical, chemical and biological methods.

[0009] Two approaches have been adopted for nano fabrication—The Top down processes, which include the methods of synthesis that carve out or add aggregates of molecules to a surface. The second is the bottom up approach, which assembles atoms or molecules into nano structures.

[0010] PHYSICAL methods include Electron beam lithography, Scanning probe method, Soft lithography, Microcontact printing, Micromoulding.

[0011] In Electron Beam Lithography, an electron beam scans the surface of a semiconductor containing a buried layer of quantum well material. The resist gets removed where the beam has drawn a pattern.

[0012] Soft lithography is an extension of the previous technique and overcomes the impracticability of applying electron beam lithography to large scale manufacturing by making a mould or a stamp, which can be used repeatedly to produce nanostructures. In Micro contact printing, the PDMS stamp is inked with a solution consisting of organic molecules called thiols and then pressed against a thin film of gold on a silicon plate. The thiols form a self-assembled monolayer on the gold surface that reproduces the stamp pattern; features in the pattern can be as small as 50 nm. In Micromoulding, the PDMS stamp is placed on a hard surface, and a liquid polymer flows into the recesses between the surface and the stamp. The polymer solidifies into the desired pattern, which may contain features smaller than 10 nm.

[0013] Scanning probe microscope can image the surface of conducting materials with atomic scale detail. Hence single atoms can be placed at selected positions and structures can be built to a particular pattern atom by atom. It can also be used to make scratches on a surface and if the current flowing from the tip of the STM is increased the microscope becomes a very small source for an electron beam which can be used to write nanometer scale patterns. The STM tip can also push individual atoms around on a surface to build rings and wires that are only one atom wide.